Hence, finally,

$$X = +\ 2\cdot21 - 13\cdot28 = -11\cdot07,$$
$$Y = +17\cdot21 - \ 0\cdot33 = +16\cdot88\,;$$

or

$$X = -11\cdot07 = 156\cdot2 \text{ miles (towards Rangoon).}$$
$$Y = +16\cdot88 = 238\cdot2 \text{ miles (towards Greenwich).}$$

The total effect of a continent equal to the North Pacific would be

$$\sqrt{X^2+Y^2} = 250\cdot6 \text{ miles,}$$

$$\tan(\phi)\frac{X}{Y} = \phi = 0^\circ\ 47' \text{ E. of } 180^\circ.$$

The total effect of a continent equal to the South Pacific Ocean would be

$$\sqrt{X^2+Y^2} = 201\cdot8 \text{ miles,}$$

$$\tan(\phi)\frac{X}{Y} = \phi = 23^\circ\ 17' \text{ E. of Greenwich.}$$

## *March* 15, 1877.

Dr. J. DALTON HOOKER, C.B., President, in the Chair.

The Presents received were laid on the table, and thanks ordered for them.

The following Papers were read :—

I. "On the Tides of the Arctic Seas.—Part VII. Tides of Port Kennedy, in Bellot Strait." (Final Discussion.) By the Rev. SAMUEL HAUGHTON, M.D. Dublin, D.C.L. Oxon., F.R.S., Fellow of Trinity College, Dublin. Received February 17, 1877.

(Abstract.)

The tidal observations at Port Kennedy were made hourly for 23 days; and in my former discussion of these tides (Part VI.) I used only the observations made in the neighbourhood of H. W. and L. W., obtaining the following results for the Tidal Coefficients :—

| *Diurnal Tide.* | *Semidiurnal Tide.* |
|---|---|
| S=23·4 inches. | S=7·0 inches. |
| $i_s = 5^h\ 12^m$. | $i_s =$ |
| M=20·9 inches. | M=17·0 inches. |
| $i_m = 0^h\ 34^m$. | $i_m = -0^h\ 12^m$. |

In the present discussion I have employed all the hourly observations made during the 23 days, and have obtained the following results :—

| *Diurnal Tide.* | *Semidiurnal Tide.* |
|---|---|
| $S = 36{\cdot}4$ inches. | $S = 5{\cdot}9$ inches. |
| $i_s = 3^h\ 2^m$. | $i_s = 2^h\ 48^m$. |
| $M = 18{\cdot}5$ inches. | $M = 15{\cdot}5$ inches. |
| $i_m = -2^h\ 48^m$. | $i_m = 6^h\ 2\frac{1}{2}^m$. |

The present more complete discussion fully confirms the result before obtained by me respecting the great magnitude of the Solar Diurnal Tide at this station, and also shows a satisfactory agreement in the other coefficients obtained from H. W. and L. W. observations only.

The method employed in the present paper is based on Fourier's Theorem, by which the height of tide is expressed as follows :—

$$F = A_0 \begin{array}{l} + A_1 \cos s + A_2 \cos 2s + \&c., \\ + B_1 \sin s + B_2 \cos 2s + \&c., \end{array}$$

where

$F$ = height of water.
$s$ = hour-angle of sun.

The coefficients $A_0$, $A_1$, $A_2$, $B_1$, $B_2$, &c., being found by well-known formulæ, they are again expressed, by Fourier's Theorem, as follows :—

$$A_n = a_0 \begin{array}{l} + a_1 \cos u + a_2 \cos 2u + \&c., \\ + b_1 \sin u + b_2 \sin 2u + \&c., \end{array}$$

where $u$ passes through all its changes in a fortnight, and the coefficients are calculated in a similar manner.

The known theoretical formulæ for the Diurnal and Semidiurnal Tides, expressed in terms of parallax, declination, lunar and solar hour-angles, are now converted into functions of the true and mean anomaly and of the sun's hour-angle, and finally into simple functions of $s$ and $u$. These expansions are now compared, term by term, with the terms of the tidal expansions found by means of Fourier's Theorem, and the final Lunar and Solar Tidal Coefficients calculated out with ease.

Although the short period of observation at Port Kennedy (23 days) renders this method of discussion not much more valuable than the usual method of H. W. and L. W. observations, I have developed it at length in the hope of applying the method to more complete series of Arctic Tides, which I hope shortly to lay before the Royal Society.

In developing this method I found it necessary to make use of the following series, for which I am indebted to my friend Mr. Benjamin Williamson, F.T.C.D. :—

$$\cos ax = \frac{\sin(a\pi)}{\pi}\left[\frac{1}{a} + 2a\left\{\frac{\cos x}{1^2-a^2} - \frac{\cos 2x}{2^2-a^2} + \frac{\cos 3x}{3^2-a^2} - \frac{\cos 4x}{4^2-a^2} + \&c.\right\}\right]$$

$$\sin ax = \frac{2\sin(a\pi)}{\pi}\left\{\frac{\sin x}{1^2-a^2} - \frac{2\sin 2x}{2^2-a^2} + \frac{3\sin 3x}{3^2-a^2} - \frac{4\sin 4x}{4^2-a^2} + \&c.\right\}$$

## II. "Studies in the Chinoline Series.—I. Transformation of Leucoline into Aniline." By Prof. James Dewar. Communicated by Prof. A. W. Williamson, Foreign Secretary of the Royal Society. Received February 19, 1877.

In a previous research* on the pyridine series of bases the formation and properties of dicarbopyridinic acid were described. This acid derivative is related to pyridine in the same manner as phthalic acid to benzol. It was then pointed out that the members of the pyridine and chinoline series bear to one another a similar relation to that of benzol and naphthaline, the following analogies being given:—

| | | | | |
|---|---|---|---|---|
| $\left\{\begin{array}{l} C_2H_2 \\ C_2H_2 \\ C_2H_2 \end{array}\right.$ | $\left\{\begin{array}{l} C_6H_4 \\ C_2H_2 \\ C_2H_2 \end{array}\right.$ | $\left\{\begin{array}{l} C_6H_4 \\ C_2H_2 \\ C_6H_4 \end{array}\right.$ | $\begin{array}{l} C_2H_2 \\ CN\,H \\ C_2H_2 \end{array}$ | $\begin{array}{l} C_5H_3N \\ C_2H_2 \\ C_2H_2 \end{array}$ |
| Benzol. | Naphthaline. | Anthracene. | Pyridine. | Chinoline. |

An extension of the work was promised in support of these theoretical relations.

Our knowledge of the chinoline series has made little progress since the masterly and exhaustive investigation of Greville Williams †, proving the isomerism of the tar and cinchona bases. The relations of these bodies are still very obscure, owing to the great stability of the bases preventing the formation of derivatives of a simpler type. Indeed some of the most interesting products obtained from these bases, such as

* "On the Oxidation Products of Picoline," Trans. Royal Soc. Edinb. vol. xxvi.

† Trans. Royal Soc. Edinb. vol. xxi.